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10/538,776	04/17/2006	Tomonobu Hata	ASAIN0164	3713

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EXAMINER	
HIGGINS, GERARD T	
ART UNIT	PAPER NUMBER
1794	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/538,776	HATA ET AL.	
	Examiner	Art Unit	
	GERARD T. HIGGINS	1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 April 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *10 June 2005* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *06/10/2005 and 09/09/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a) because they fail to show certain details as described in the specification.

a. With regards to Figure 4, the temperature gradient for the average thermal treatment temperatures 0 to 400 °C is not shown. This temperature gradient should be shown because it corresponds to the same average thermal treatment temperatures of Figure 5.

b. With regards to Figure 6, in the Brief Description of the Drawings the y-axis is referred to as electromotive voltage; yet, in the Figure it states electromotive power.

c. Figure 3 is objected to because it does not include all of the layers **12** and **13** in the 14-layer arrangement as described at page 24, lines 14-19.

d. In Figure 6, the temperature increase data points are not shown as in Figure 5; further, the entire average thermal treatment temperature of Figure 5 is not shown.

e. In Figure 8A, the temperature gradient for the average thermal treatment temperatures 0 to 400 °C is not shown.

f. In Figure 8B, the "temperature increase" data points are not shown.

g. In Figure 7A and B, applicants state that the gradient temperature for these average thermal treatment temperatures was "slightly different" from that of Figure 5 (specification pg. 28, lines 21-24). How different is the treatment? Additionally, Figure 4 shows the gradient temperatures for Figure 5; however, it fails to completely show the average thermal treatment temperatures from 0 to 700 °C.

Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If

the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to because:

a. In Figure 9A the arrows showing “temperature increase” and “temperature decrease" are not shown.

b. In Figure 9A-C, applicants have not specifically provided the gradient temperatures of these embodiments (please see specification pg. 26, lines 7-15).

c. In Figure 8B, the "temperature decrease” name for the arrow is not shown.

d. In Figure 9A-C, the “temperature increase” and “temperature decrease" titles of the arrows are not shown.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application

must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: the gradient temperature **7** is not seen in Figure 1C (please see specification pg. 8, lines 13 and 26, and pg. 9, line 6). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

5. The disclosure is objected to because of the following informalities:

a. The term "digits" seen in this specification at various places (e.g. pg. 9, line 17) is an unclear term.

b. The sentence at pg. 7, lines 21-23 is awkward.

c. The sentence at page 13, lines 8-10 is awkward.

d. The sentence at page 14, lines 7-11 is awkward; additionally, what gas is referred to here?

e. The section at page 19, lines 20-27 is awkward; additionally, a "terminating process" is not understood from the specification.

f. On page 20, lines 25-27 the 100 degree C per millimeter does not agree with the Figures.

g. The sentence at page 21, lines 14-17 is awkward.

h. At page 25, lines 9-13 considering the disclosure if the gradient temperature continues to change "at a constant value of about 10 to 15 degree C per 8 mm per 100 degree C when the temperature increase or decrease" that would necessarily imply a negative temperature gradient (according to Figure 4) when the average thermal treatment temperature is decreased to 200 °C and temperatures below. Is this possible? The same objection is made with regard to the passage at page 27, lines 17-20.

i. At page 25, line 26 applicants state a minimal specific resistance; however, this appears to be a maximum amount.

j. At page 28, line 6 applicants state electromotive power; however, it appears to be electromotive force or voltage.

k. At page 28, line 7 applicants state "in the vicinity of normal temperature." What is "normal temperature?"

l. The section at page 28, lines 13-20 is awkward and unclear. What are applicants stating is new? This section appears to be contradicting itself as it appears that applicants are also using a thermal effect.

Appropriate correction is required.

6. A substitute specification including the claims is required pursuant to 37 CFR 1.125(a) because the specification is replete with sentence structure that leads to confusion as to what applicants' invention is, and therefore a substitute specification in proper idiomatic English and in compliance with 37 CFR 1.52(a) and (b) is required. The substitute specification filed must be accompanied by a statement that it contains no new matter.

A substitute specification must not contain new matter. The substitute specification must be submitted with markings showing all the changes relative to the immediate prior version of the specification of record. The text of any added subject matter must be shown by underlining the added text. The text of any deleted matter must be shown by strike-through except that double brackets placed before and after the deleted characters may be used to show deletion of five or fewer consecutive characters. The text of any deleted subject matter must be shown by being placed within double brackets if strike-through cannot be easily perceived. An accompanying clean version (without markings) and a statement that the substitute specification contains no new matter must also be supplied. Numbering the paragraphs of the specification of record is not considered a change that must be shown.

7. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the subject matter of claims 5 (dilute reactive gas) and 14 (impurities of metal elements) is not found in the specification.

Claim Objections

8. Claim 13 is objected to because of the following informalities: "he" appears to be a typographical error. Appropriate correction is required.

Claim Rejections - 35 USC § 112

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 1-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With regard to claims 1-23, it is unclear whether applicants are claiming the final product made by thermally treating the functional materials on the substrate, or rather the initial materials, which would then be treated in a thermal process.

The term "dilute reactive gas" in claim 5 is a relative term which renders the claim indefinite. The term "dilute reactive gas" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary

skill in the art would not be reasonably apprised of the scope of the invention. It is unclear what concentration comprises “dilute;” furthermore, it is unclear to what an extent a gas must be reactive in order to be considered a "reactive gas.” These issues are significant enough to render these claims indefinite.

The term “Si process” in claim 16 is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Although this limitation is an intended use limitation it still renders the claim indefinite because it is unclear exactly what a silicon process comprises.

With regard to claim 14, applicants state “impurities of metal elements of the groups 2, 3, 5, 6.” This is unclear because it is not the proper nomenclature with respect to the Periodic table of Elements, and therefore there is confusion as to what columns applicants are referring. Additionally, applicants provide no examples of these impurities in the specification. For the purpose of examination, the Examiner will treat this as including the columns that comprise boron (Group III), nitrogen (Group V), and oxygen (Group VI). Having said that there is the additional indefiniteness in the fact that the elements just stated are not metals.

The term "rapid" in claim 15 is a relative term which renders the claim indefinite. The term "rapid" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Applicants have not stated with what basis a physical property change would be considered rapid.

Claim Rejections - 35 USC § 102/103

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 1-16 and 18-23 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Sadatomi et al. (EP 1083610).

Sadatomi et al. disclose layered semiconductors on silicon wafer substrates that comprise thermoelectric conversion materials [0054] to [0061] and also Figures 7A and 8.

Fig. 7A

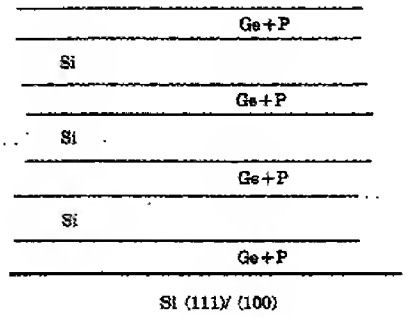
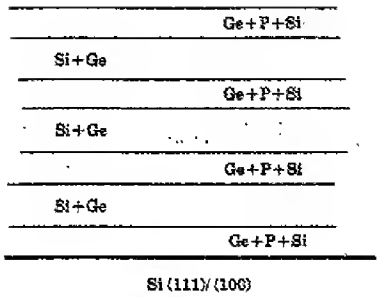


Fig. 8



With regard to claims 1, 8, and 10, the substrate is disclosed at [0054] and may comprise a silicon wafer. The functional material is the alternating layers of silicon and doped germanium. The material may be heat treated as seen at [0056] and [0061]. With regard to the term "gradient temperature," it is a broad enough term such that it encompasses embodiments wherein there is a constant temperature difference between the two ends of the functional material. These embodiments are explicitly stated in applicants' claims 8 and 10, and as such they are also anticipated by the disclosure of Sadatomi et al.

With regard to claims 2, 19, 22, and 23, the device is a thermoelectric device, which necessarily means that the "functional material is in connection with properties of an electrically conductive carrier" as seen in claim 2, and also it would have electric conductivity as seen in claim 19. At [0060] Sadatomi et al. state that the device may be made from a plurality of p-n junction materials as claimed in claim 22. Figures 7A and 8 show that the functional material may be made from a "stacked structure of different types of layered materials" as claimed in claim 23.

With regard to claims 20, an electromotive effect is a characteristic inherently made use of in thermoelectric devices, and therefore the thermoelectric device of Sadatomi et al. would inherently make use of the electromotive effect.

The Examiner notes the presence of product-by-process limitations in applicants' claims 1, 3-11, 15, 18, and 21. Specifically included in these claims is the manner in which the alternating layers of semiconductor materials are heated in order to arrive at a thermoelectric device. It has been held that "even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." Please see MPEP 2113 and *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

At [0061] Sadatomi et al. teach that "the treatment conditions for the selected means will vary considerably with the combination of elements when two or more are used, so the above-mentioned means and conditions must be appropriately selected according to the targeted composition. As for the heat treatment, any temperature conditions, atmosphere, and heating method can be employed as long as the conditions result in the desired diffusion between the layers." This ultimately is the effect of the product-by-process limitations of applicants' claims 1, 3-11, 15, 18, and 21, which the Examiner submits is anticipated by the statement of Sadatomi et al. presented immediately above; alternatively, it would have been obvious to one having ordinary skill

in the art of thermoelectric devices to vary the heating methods and temperatures to arrive at a device having the proper Seebeck coefficients, specific resistance, or electromotive force/voltage.

Additionally, with regard to claim 5, Sadatomi et al. teach at [0061] that a gas containing an added element may be used to dope the semiconductor layers. Additionally, all of the dopants are discussed from [0062] to [0078].

With regard to claim 11, the silicon and germanium layers of Sadatomi et al. would inherently be amorphous as they are formed in an equivalent manner as applicants propose [0061] (vapor deposition, CVD, sputtering, discharge plasma treatment, etc.).

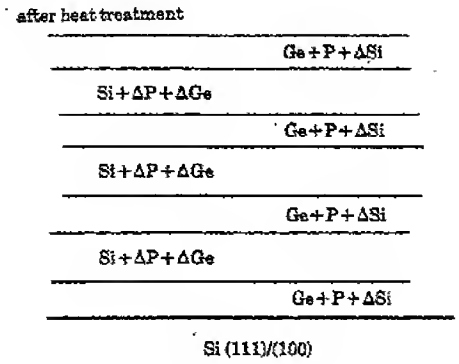
With regard to claim 12, considering that the materials used by applicants and Sadatomi et al. are equivalent (Si and Ge), the materials of Sadatomi et al. would inherently display a coefficient of thermal expansion of the functional material and the substrate that are substantially equal.

With regard to claim 13, the alternating layers of Si and Ge seen in Figures 7A and 8 of Sadatomi et al. comprise the singular or multiple elements of applicants' claim 13.

With regard to claims 14, at [0071] to [0075] Sadatomi et al. teach using Group 2-6 elements as dopants in their thermoelectric device.

With regard to claim 15, the heat treatment conditions of Sadatomi et al. would form a device of Figure 7B.

Fig. 7B



In this device there is a physical property change because the layers are now a mixture of all of the individual layers.

With regard to claim 16, the substrate clearly can comprise silicon.

14. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sadatomi et al. (EP 1083610), as applied to claim 1.

Sadatomi et al. discloses or renders obvious all of the limitations of applicants' claim 1 in section 13 above; however, it fails to specifically disclose a layer of oxide or nitride provided over the substrate layer.

At [0060] Sadatomi et al. teach that the thermoelectric device may be comprised of p-n semiconductor type materials, they also teach the layered Si and Ge semiconductor structure in Figures 7A, 7B, and 8; further at [0067] and [0068] they teach that boron may be doped to provide holes (p-dope), and oxygen or nitrogen may be used to provide electrons (n-dope) in the semiconductor.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to make a layer of oxide or nitride on the silicon substrate in order

to further tune the doping concentration of holes or electrons in the semiconductor to provide the correct amount of specific resistance or electromotive force/voltage throughout the thermoelectric device.

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The other "X" reference on the international search report are considered cumulative to the present rejection; further, the Examiner has provided a section of the CRC Handbook of Chemistry & Physics concerning the various parameters of semiconductors.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GERARD T. HIGGINS whose telephone number is (571)270-3467. The examiner can normally be reached on M-F 7:30am-5pm est. (1st Friday off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Callie Shosho can be reached on 571-272-1123. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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